Laboratory and Field Observations on the Bionomics of Epilachna vigintioctopunctata Fabr. and Epilachna dodecastigma Muls.

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT
FOR THE DEGREE OF
MASTER OF PHILOSOPHY
IN
ZOOLOGY

BY
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DEPARTMENT OF ZOOLOGY
ALIGARH MUSLIM UNIVERSITY
ALIGARH
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DEDICATED

TO

MY

FATHER AND MOTHER

IN

GRATITUDE

I certify that the present studies on the "Laboratory and field observations on the bionomics of Epilachna vigintioctopunctata and Epilachna dodecastigma" is the original work of Mr. Badar Iftekhar and is suitable for submission for the award of the degree of Master of Philosophy of the Aligarh Muslim University, Aligarh. This work has been done by the candidate under my supervision.

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INTRODUCTION

The family coccinellidae comprises nearly 5000 species of characterstically spotted, variously coloured, medium sized insects which are commonly known as ladybird beetles. They are usually carnivorous in habit and some of them have been effectively used as biological control agents since 1889, when Rodolia cardinalis (Muls.) was successfully employed for combating the fluted scale Icerya purchasi mask. Members of genus Epilachna are however, herbivorous and cause serious damage to a number of solonaceous and cucurbitaceous plants like brinjel, tomato, potato, gourds, melons and cucumbers (Krishnamurthy 1932; Puttarudrish and Krishnamurthy 1954; Mathur and Srivastava 1964; Krishna and Sinha 1969;). They scrap the epidermal layer of the leaves and other tender parts of host plant. Two such species which are commonly found feeding on economically important plants in northern India are Epilachna vigintioctopunctata and Epilachna dodecastigma.

Coccinellids are cosmopolitan in distribution and more than 300 species have been described from India. It is however, surprising that inspite of all their economic importance very little is known regarding the bionomics of these beetles and only some brief notes on the habits of the predaceous

species have been published. Phytophagous species, have almost been completely left out and all that one finds in the literature are a few suggestions on their control. The present studies were, therefore, undertaken to study the bionomics of Epilachna vigintioctopunctata and Epilachna dodecastigma and to find out the intensity of their attack on certain varieties of brinjal plants in Uttar Pradesh.

REVIEW OF LITERATURE

Coccinellids are of considerable importance and are commonly found feeding on other organisms such as aphids, coccids and mites. A comparative study of eight species of the lady beetles with respect to their predatory habits was made by Clausen (1918). It was found that the number of aphids consumed differed with the species of predator, so that a larva of Coccinella sanguinea consumed 216 aphids while that of Coccinella californica needed 478 aphids to complete its development. But all species of coccinellids are not predatory in nature. Some of them, such as the members of the genus Epilachna are serious pests of vegetables and feed upon the leaves and other tender parts of the solonaceous and cucurbitaceous plants. (Krishnamurthy 1932; Krishnamurthy and Puttarudriah 1954; Mathur and Srivastava 1964;). The congregating beetles, when disturbed, discharge an ambour coloured bitter, defensive poisonous hypodermal fluid, from pores situated around tibio-femoral articulations (McIndo 1916).

Chue (1928) found Epilachna 28- punctata feeding upon the leaves of cucurbitaceous and solonaceous plants in Kwantung province of China, where as Van der Goot (1928) reported that Epilachna 28-punctata caused serious damage to solonaceous and cucurbitaceous plants in Java.

Krishna and Sinha (1969) studied the feeding behaviour and chemosensory relationship of Epilachna vigintioctopunctata to Luffa agyptiacea and concluded that the beetles preferred to feed on flowers, and the chemoreceptors situated on the antennae were the chief olfactory sensilla. They observed that 65.0% beetles took their first bite within 15 seconds when both or one antenna was intact, while only 20.0% took their first bite during this period when both the antennae were removed.

Jack (1913) found that Epilachna dregi and Epilachna hirta attacked potato plants in southern Rhodesia and defoliated them. They also acted as vectors of fungal and viral diseases of potatoes. Kapur (1942) observed Brumus suturalis feeding on mites, psyllids, aleurodids, aphids and coccids all over India, Ceylon and Phillipines. Krough (1926), reported Coccinella septumpunctata predating Pyrausta nubilalis while Wallace (1926) found Coccinella sanguinea feeding on Periphyllus species. Rai and Gopal (1972) noticed that besides feeding on the leaves of brinjel, Epilachna vigintioctopunctata also attacked the fruits and reduced their economics value.

The effects of temperature and moisture on the survival of the preadult and the adult stages of Epilachna varivestis were studied by Muller (1930). It was found that the adults were most sensitive to these factors than either the larvae or

the pupae. At 37.5°C normal survival was observed at all humidities, but the rate of mortality was found to be considerably high when the humidity was below 60.0% or more than 80.0%. When at an optimum relative humidity of 73.0% the temperature was raised from 38.5°C to 39.5°C to 40.5°C to 41.5°C, the survival rate reduced from 80.4% to 66.5% to 34.0% respectively.

Douglass (1928) studied the phenomenon of emergence of Epilachna corrupta from hibernation and found that percent emergence during rainy season was directly dependant on temperature conditions. Emergence was rarely observed below a mean temperature of 12.8°C which reached its peak at a temperature of 15.0°C.

Kapur (1942), studied the bionomics of Adonia variegata, Brumus suturalis and Scymnus quadrillum. It was observed that 29.6°C was most suitable for the development of Adonia varigata, and the entire development was completed in only 12.3 days. A longevity of 34.0 days of females at 29.6°C was reduced to 25.0 days and 16.7 days at 25.0°C and 32.0°C respectively. Similarly, the males which lived for 28.0 days at 29.6°C survived for only 21.0 days and 15.2 days at 25.0°C and 32.0°C respectively.

Bagal (1945) studied the bionomics of certain predaceous

coccinellids. It was observed that a duration of 16.2 days required in the month of October, for the development of Coccinella septumpunctata, was prolonged to 18.8 days during the winter months of January and February.

Mumma (1958) studied the effects of temperature on the development of various stages of Chilochorus stigma. The incubation period which lasted for 7.28 days at 80.0°F was prolonged to 12.6 days and 15.0 days at 70.0°F and 62.0°F respectively. Larval duration was also prolonged from four to six weeks when the temperature dropped down from 80.0°F to 70.0°F. Fecundity was dependant on the availability of food and it was found that 10 females which fed on florida red scale laid 324 eggs, whereas only 80 and 3 eggs were laid when they were allowed to feed on florida red scale and purple red scale on alternate days and only on purple red scale.

Wallis and Douglass (1958) studied the winter mortality of Epilachna varivestis for six seasons during the years 1929-30 and 1934-35 in the eastern valley of New Mexico. It was observed that excessively dry as well as wet conditions resulted in the hibernation of the adults. At 10.0°F all the beetles exposed to wet leaves and 90.0% of those on dry leaves were killed. At 21.0°F, the mortality was 90.0% in wet leaves and 20.0% in dry leaves. Only 3.0% mortality could be observed in moist leaves at 30.0°F.

Attallah (1966) studied the effect of crowding on the fecundity of Coccinella maculata and concluded that oviposition was effected not only by the number of individuals present in a cage but also on their sex ratio. The number of eggs laid by a female decreased with an increase in the number of adults and the maximum number of eggs was obtained when the mated females were kept alone. The number of eggs laid was greater in single pair crossings than in mass crossings.

MATERIALS AND METHODS

Test insects belonging to the species Epilachna vigintioctopunctata were collected from fields in and around Aligarh district and were reared at a temperature of 27±1°C and 60 to 70% relative humidity in rearing jars measuring 6"x3" in size. Fresh brinjel leaveswere provided as food, which was changed after every twentyfour hours. Eggs were laid in batches on the underside of leaves and the leaves bearing the eggs were transferred to other jars for further observations. Newly hatched larvae were kept on fresh brinjel leaves to observe moultings as well as pupation. Single pairs of Epilachna vigintioctopunctata were kept in small beakers of 500 ml. capacity in order to obtain reliable base line data on the bionomics of the species.

The population density of Epilachna vigintioctopunctata and Epilachna dodecastigma was studied at Sindia fort, Aligarh. Observations were made on alternate days for one year, starting from June 1, 1976 to May 30, 1977 in three brinjel plots, grown by the Botany Department of the University. The number of adults of both the species present on randomly selected brinjel plants was counted for three hours. For convenience the observation period of one year was divided into 48 weeks and

the mean population density of both the species was determined. An attempt was also made to find out the effects of temperature and humidity on the seasonal abundance of the two species.

SEASONAL ABUNDANCE

OF

EPILACHNA VIGINTIOCTOPUNCTATA AND EPILACHNA DODECASTIGMA

Field studies on the seasonal abundance of Epilachna vigintioctopunctata and Epilachna dodecastigma were made in three brinjal plots at Sindia fort, Aligarh. Observations were recorded on alternate days and the number of adults of both the species present on randomly selected brinjal plants was counted over a period of three hours. The size of the three experimental plots varied from 1060 square feet to 1120 square feet and each of them contained a different variety of brinjal.

In plot A, having an area of 1060 square feet, the brinjal variety of grown was an hybrid of Solanum melongena pusa purple long X Solanum insanum. There were 70 plants in this plot. Plot B, with an area of 1080 square feet and 75 plants had two brinjal varieties, which were hybrids of Solanum melongena Hungary 290469 X Solanum insanum and that of Solanum melongena pusa purple long X Solanum insanum. 72 plants belonging to the species Solanum melongena baromashi were grown in plot C, having an area of 1120 square feet.

The population density of Epilachna vigintioctopunctata and Epilachna dodecastigma was found to be greatly dependent on the physical environment. Temperatures ranging from 27.0°C to

29.0°C was favourable for the occurance of both the species of beetles. Thus during the months from July to October, when the mean temperature varied from 27.45°C to 28.87°C, both species could be abundantly found in the field. The beetles were most abundant in the second week of August. Under these conditions the population density of Epilachna vigintioctopunctata per plant in plots A,B and C was seventytwo, sixtyfour and sixteen. Similarly the average number of Epilachna dodecastigma collected from a single plant in the plots A,B and C was sixtytwo, fiftytwo and twelve beetles only. (Figure 1-3). When the temperature dropped down and ranged from 20.0°C to 24.0°C in the month of November, the population of beetles was also found to have declined and at temperatures, ranging from 13.2°C to 17.6°C during the months of December, January and February, there was almost a complete absence of the beetles from the field. A temperature of more than 30.0°C during the month of April and May was also unfavourable for the occurrance of beetles and a significant decrease in the population density of Epilachna vigintioctopunctata and Epilachna dodecastigma could be observed.

Humidity had a marked effect on the abundance of Epilachna vigintioctopunctata and Epilachna dodecastigma. During the months from July to September, when the relative humidity varied from 74.2% to 86.99% both the species could be abundantly found in the field. However, when the relative humidity became less than 60.0% in the month of October, without any significant change in temperature, the beetles population also declined considerably.

While studying seasonal variations in the population of Epilachna vigintioctopunctata and Epilachan dodecastigma, the comparative resistance of brinjel varieties, to the attack of the beetles was also studied. This was done by counting the number of adults present in three plots, each of which had a different variety of brinjel plants.

Epilachna vigintioctopunctata was found to be most abundant in plot A, where hybrids of Solanum melongena pusa purple long X Solanum incanum were grown. In this plot 54.25 beetles per plant could be collected during the month of August as compared to 11.39 beetles per plant in plot C, where Solanum melongena baromashiwere grown. This may indicate that the Solanum melongena baromashi is comparatively more resistant to the attack of Epilachna vigintioctopunctata than the hybrid of Solanum melongena pusa purple long X Solanum incanum.

Similarly the population density of Epilachna dodecastigma was greater in plot A than plot C. The average number of beetles per plant in plot A was 48.16 where as in plot C only 6.81 beetles per plant could be found. This suggests that Solanum melongena baromashi is relatively more resistant to the attack of Epilachna dodecastigma than the hybrid of Solanum melongena pusa purple long X Solanum incanum.

FIGURE- 1

Seasonal abundance of *Epilachna virintioctopunctata* and *Epilachna dodecastigma* in plot -A.

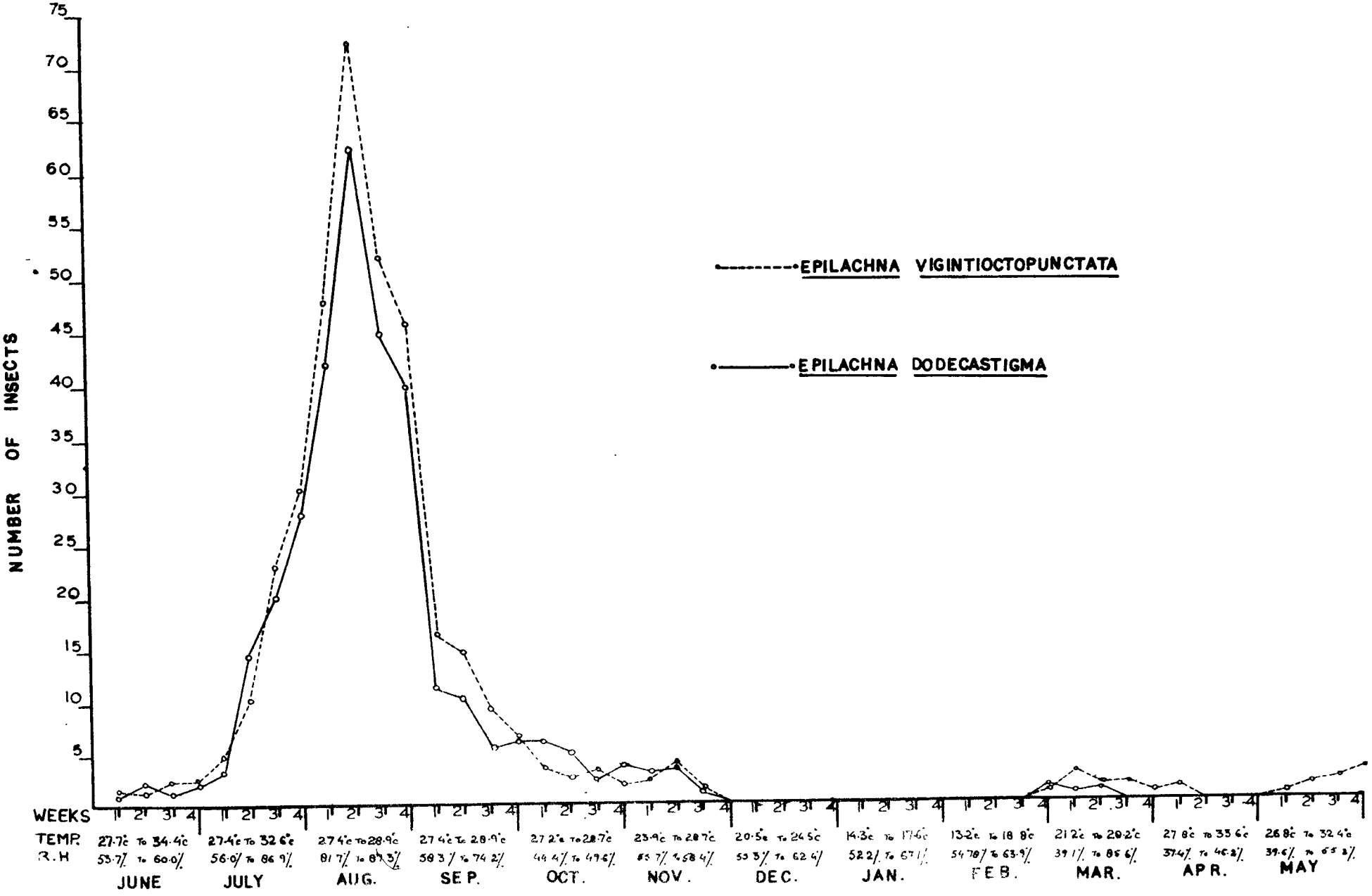

NUMBER OF INSECTS
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
EPILACHNA VIGINTIOCTOPUNCTATA
EPILACHNA DODECASTIGMA
WEEKS
1 2 3 4
TEMP. 27·7°c To 34·4°c
R.H 55·7% To 60·0%
JUNE
TEMP. 27·4°c To 32·6°c
R.H 56·0% To 86·9%
JULY
TEMP. 27·4°c To 28·9°c
R.H 81·7% To 89·3%
AUG.
TEMP. 27·4°c To 28·9°c
R.H 58·3% To 74·2%
SEP.
TEMP. 27·2°c To 28·7°c
R.H 44·4% To 49·6%
OCT.
TEMP. 23·9°c To 28·7°c
R.H 65·7% To 58·4%
NOV.
TEMP. 20·5°c To 24·5°c
R.H 55·3% To 62·4%
DEC.
TEMP. 14·3°c To 17·6°c
R.H 52·2% To 67·1%
JAN.
TEMP. 13·2°c To 18·8°c
R.H 54·78% To 63·9%
FEB.
TEMP. 21·2°c To 29·2°c
R.H 39·1% To 85·6%
MAR.
TEMP. 27·8°c To 33·6°c
R.H 37·4% To 46·2%
APR.
TEMP. 26·8°c To 32·4°c
R.H 39·6% To 65·2%
MAY

FIGURE 2

Seasonal abundance of Epilachna viridioctomaculata and Epilachna dodecastigma in plot -B.

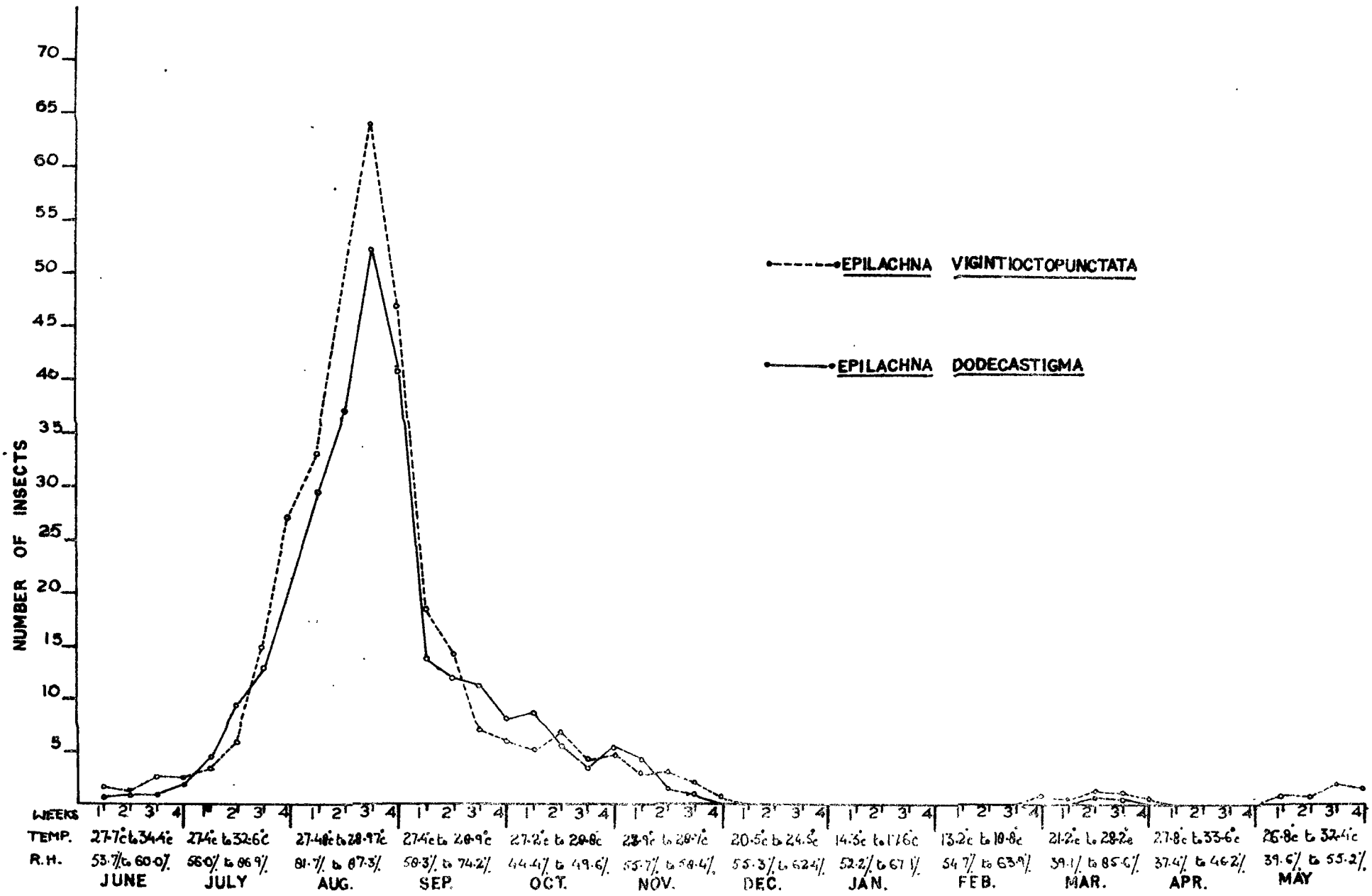
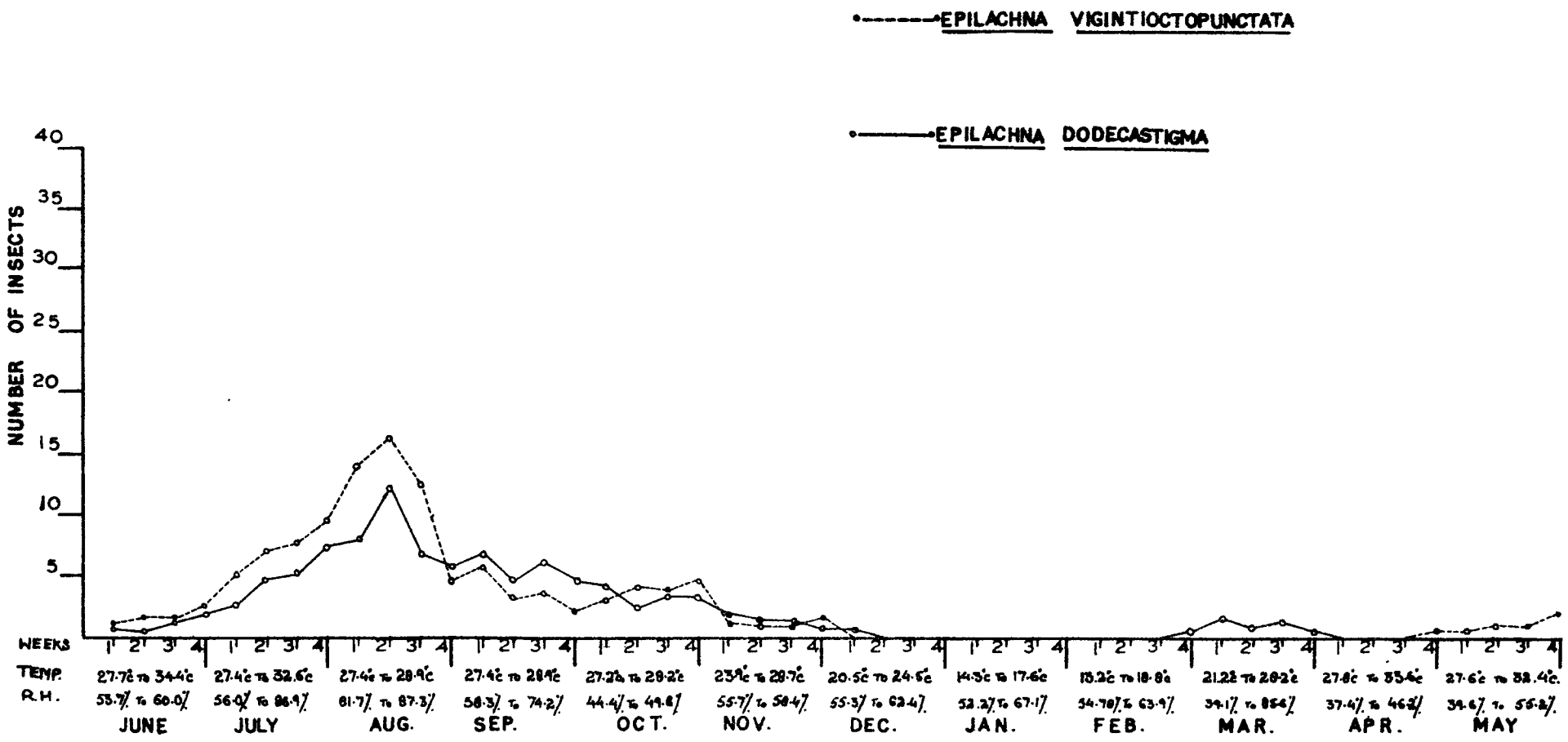

NUMBER OF INSECTS
70
65
60
55
50
45
40
35
30
25
20
15
10
5
EPILACHNA VIGINTIOCTOPUNCTATA
EPILACHNA DODECASTIGMA
WEEKS 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | 1 2 3 4
TEMP. 27·7°c to 34·4°c | 27·4°c to 32·6°c | 27·4°c to 28·9°c | 27·4°c to 28·9°c | 27·2°c to 29·8°c | 23·9°c to 28·1°c | 20·5°c to 24·5°c | 14·5°c to 17·6°c | 13·2°c to 19·8°c | 21·2°c to 28·2°c | 27·8°c to 33·6°c | 26·8°c to 32·4°c
R.H. 53·7% to 60·0% | 58·0% to 86·9% | 81·7% to 87·3% | 58·3% to 74·2% | 44·4% to 49·6% | 55·7% to 58·4% | 55·3% to 62·4% | 52·2% to 67·1% | 54·7% to 63·9% | 39·1% to 85·6% | 37·4% to 46·2% | 39·6% to 55·2%
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY

FIGURE- 3

Seasonal abundance of Epilachna virintioctomaculata and Epilachna dodecastigma in plot -C.


EPILACHNA VIGINTIOCTOPUNCTATA
EPILACHNA DODECASTIGMA
NUMBER OF INSECTS
40
35
30
25
20
15
10
5
WEEKS
1 2 3 4
TEMP.
R.H.
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY

LABORATORY OBSERVATIONS ON THE BIONOMICS OF EPILACHNA VIGINTIOCTOPUNCTATA

Since no baseline data is available on the bionomics of Indian species of Coccinellids, an attempt was therefore, made to study the bionomics of Epilachna vigintioctopunctata, which is a serious pest of Solonaceous and Cucurbitaceous plants in this country. Adults were collected from fields in Aligarh district and were brought to the laboratory, where they were kept in rearing jars, measuring 6"x3" in size, at a temperature of 27±1°C and 60-70% relative humidity. They were fed on brinjal leaves which were changed after every twentyfour hours.

Copulation and oviposition- Under laboratory conditions, the adults started copulating 6 to 8 days after emerge and the newly emerged adults copulated for about an hour. The duration of copulation was considerably reduced in successive copulations which lasted for 20 to 30 minutes only.

Epilachna vigintioctopunctata readily oviposited under laboratory conditions. Eggs were laid in batches on the under-surfaces of the brinjal leaves with their long axis perpendicular to leaf surface. The maximum number of egg in batch was 73. Occasionally the eggs were laid singly as well.

Observations on the pr-oviposition, oviposition and postoviposition periods were made in the case of 15 pairs which were kept separately in small beakers of 500 ml. capacity. It was found that the preoviposition period of Epilachna vigintioctopunctata varied from 14 to 19 days while the oviposition period lasted from 26 to 34 days. The number of eggs deposited by a single female during its oviposition period varied from 107 to 238. Eggs were laid intermittently and it was found that 6.0 of the eggs,laid during the later stages of the oviposition period, were sterile. The postoviposition varied from 22 days to 36 days.

Eggs- The eggs of Epilachna vingintioctopunctata are small, elliptical in shape. They measure from 1.1187 mm to 1.2204 mm. in length and .4407 to .5088 mm. in width. When freshly laid they are bright yellow in colour but as the development proceeds, the colour changes to light yellow. During the present studies the incubation period lasted for 4 to 8 days.

Larvae- The larvae belonging to different species of genus Epilachna differ considerably in their morphology. All of them are however, voracious plant feeders. There are four larval instars in the case of Epilachna vingintioctopunctata and these may be distinguished as follows:

First instar-(Figure 4-b)- The first instar larva is quite lethargic and crawls out by breaking the egg shell. It usually

remains, near the egg shell and does not feed for about twenty-four hours. Two to four hours old first instar larva measure 1.1596 to 1.2543 mm. in length and .4238 to .5254 mm in width. The head is large and subrounded. There are three ocelli. Antennae are two segmented, the first segment is shorther than broad. The prothorax is wide and half as long as head. On the dorsal prothoracic surface there is a transverse row of four equally spaced dorsal and subdorsal scoli. Dorsal scoli are short, broadly conical and bear short branches, each of which has a rather cylendrical apical seta. Subdorsal scolus comprises of branched filiform process. Dorsolateral scoli resemble the dorsal scoli. Mesothorax as well as metathorax bear similar small spines. The abdomen is nine segmented with one small additional somewhat indistinct segment at the end. Dorsal scoli are situated on each segment close to one another while the subdorsal scoli are iin line with the corresponding ones on the metathorax. Dorsolateral scoli are smaller than the subdorsal of the same segment and decrease in size in each of the succeeding segment. The first instar larva moulds into the second instar larva in 73 to 75 hours.

Second Instar(Figure 4-c)- The second instar larva measure from 2.3053 mm. to 2.4599 mm. in length and .7799 to .8644 mm. in width. It resembles the first instar except that abdomen is bent and this gives thee larva a hump back appearance. The scoli on the pronotum are much closer together than in the case of the first instar larvae. Thoracic and the first few abdominal segments are wider than the head. The instar is of

shorter duration lasting for 66 to 68 hours.

Third Instar(Figure 4-d)- The third instar larva is 3.0849 to 3.2713 mm. long and .8475 to 1.0509 mm. wide. It resembles the second instar except that the dark stripes on either side of the middorsal line of the thorax became very distinct. This instar requires 86-90 hours to complete its development.

Fourth Instar(Figure 4-e)- The fourth instar larva can be easily distinguished by its large size. It measures from 4.7799 to 5.0173 mm. in length and 1.4238 to 1.7119 mm. in width. The colour markings at the base of the spines become very distinct. After 4 to 5 days the fourth instar larva moults into a pupa. Measurements of the head, thorax and abdomen for first, second, third, fourth instar are given in table- I.

Table- I

Average measurements of head, thorax and abdomen.

Sl No	Body Region	First Instar		Second Instar		Third Instar		Fourth Instar	
		Length in mm	Width in mm	Length in mm	Width in mm	Length in mm	Width in mm	Length in mm	Width in mm
1	Head	.3081	.3220	.3898	.4915	.6721	.6610	.6780	.8966
2	Thorax	.3390	.3729	.6271	.7458	.8674	.9322	1.1356	1.2204
3	Abdomen	.4068	.4407	1.3051	.7966	1.6272	1.0831	2.9323	1.4236

The existence of four larval instars was ascertained with the help of Lyar's Law (1890). By dividing each observed width of the head with that of the preceding instar, the ratio of increase in each instar was determined. The average of such ratios was found to be 1.42. By using this ratio as a factor, the width of the head capsule of various instars was calculated and found to be as follow.

Table- II

Average observed width of the head capsule

S.No.	Instar	Average width
1	First	.3220 mm.
2	Second	.4915 mm.
3	Third	.6610 mm.
4	Fourth	.8966 mm.

Table- III

The ratio of the width of head capsule

S.No.	Instar	Ratio	Mean
1	Second: First	.4915 / .3220 mm. =1.52	
2	Third : Second	.6610 / .4915 =1.34	1.42
3	Fourth: Third	.8966/ .6610 =1.35	

Table- IV

Calculated width of head capsule

S.No.	Instar	Calculated width
1	Second	.3220 x 1.42 = .4672 mm.
2	Third	.4915 x 1.42 = .6979 mm.
3	Fourth	.6610 x 1.42 = .9386 mm.

Table- V

Comparison of observed width with calculated width

S.No.	Instar	Observed width	Calculated width
1	First	.3220 mm.	.3220 mm.
2	Second	.4915 mm.	.4672 mm.
3	Third	.6610 mm.	.6979 mm.
4	Fourth	.8966 mm.	.9386 mm.

As the calculated widths do not depart considerably from measured ones, it can be concluded that no ecdysis was overlooked

and that there are four larval instars in the case of Epilachna vigintioctopunctata.

Pupa -(Figure 4-F)

Pupation takes place upon the leaves. Before pupating the larva attaches its abdominal segment to a leaf by means of a viscous substance and bends the anterior portion of the body. With the splitting of the larval covering along the middorsal line of the thorax, the larva exposes itself as a whitish pupa. The pupa assumes a rather ovate outline. The brown markings on the dorsal surface begin to appear gradually. On the ventral side, wing covers and legs can be distinguished. The whole body is covered with bristles. As the pupal period advances, the pupa becomes yellowish in colour. The duration of pupal period was found to be 4 to 5 days.

Emergence -

The beetles emerge by breaking the pupal coverings longitudinally along the dorsal median line of the thorax. About thirteen minutes are required for the beetles to free themselves from the pupal coverings. Within the next three hours, the wings become hardened and adults start feeding on the host plants.

Adult -(Figure 4-G)

The redish brown adult of Epilachna vigintioctopunctata, with 28 black spots of variable size, is oval in outline and measures from 4.28 mm. to 6.54 mm. in length and 2.86 mm. to 4.12 mm. in width. The head is not prominent and the antennae are 13 segmented, almost hidden under the head. The beetles when disturbed, discharge an amber coloured fluid from pores situated around tibiofemoral articulations.

FIGURE- 4

Egg and developmental stages of

Epilachna vigintioctopunctata

A- Egg

B- First instar

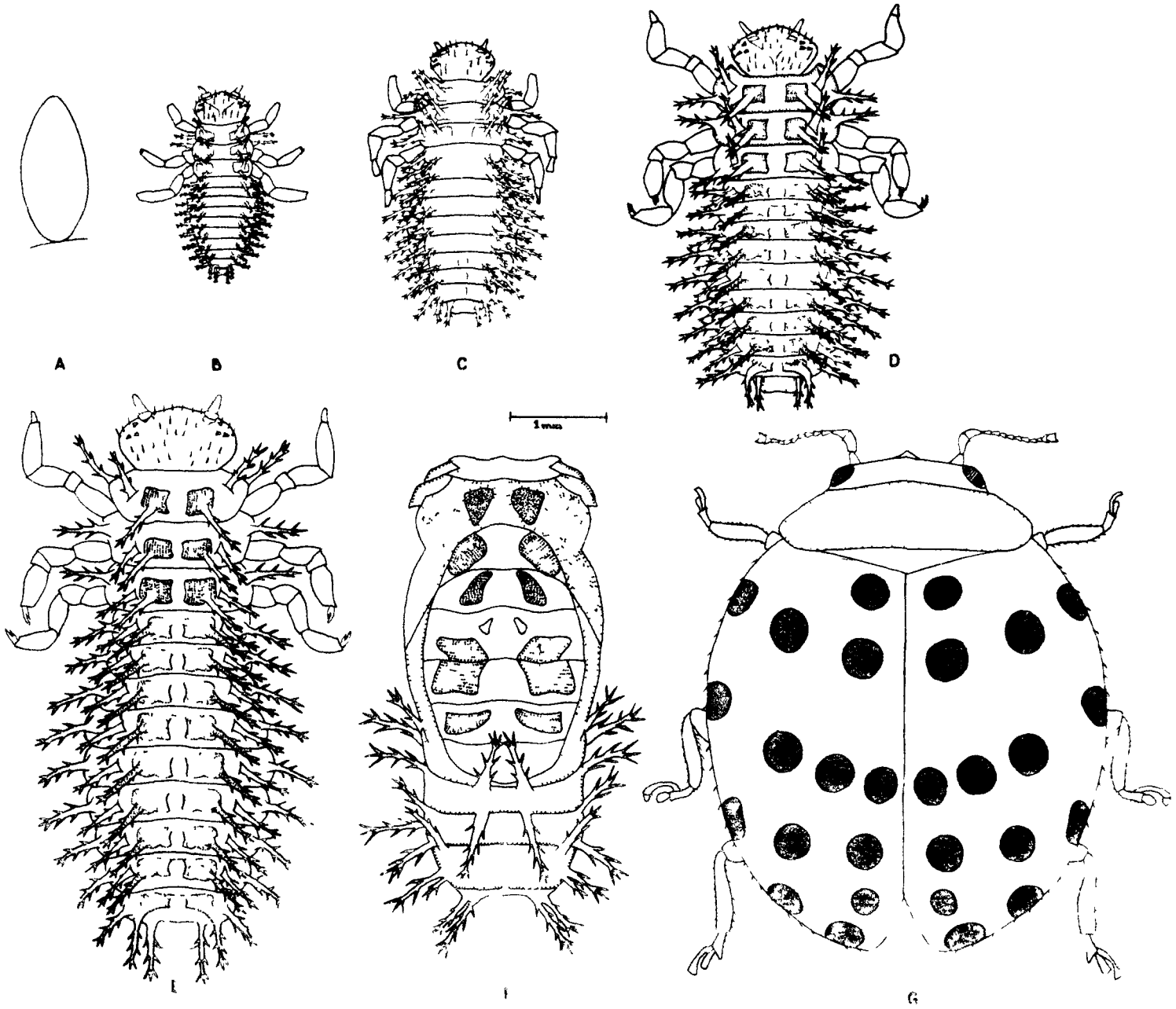
C- Second instar

D- Third instar

E- Fourth instar

F- Pupa

G- Adult


A
B
C
D
1 mm
E
F
G

DISCUSSION

Marked fluctuations in the field population of Epilachna vigintioctopunctata and Epilachna dodecastigma could be observed during the various seasons of the year. Such fluctuations were largely dependent upon temperature and humidity conditions. The population was almost negligible during the month of June when the temperature was very high and rose upto 34.4°C. However, in July, the population of both the species increased at a rapid rate and reached its peak in the second week of August. The mean temperature and humidity during this period varied from 27.45 to 28.87°C and 81.7% to 87.99% respectively. A temperature of 27.0°C to 29.0°C and 81.7% to 87.99% relative humidity can therefore be said to be extremely favourable for the occurance of these species. The population after this peak declined slowly and the descending trend continued upto the last week of November. This may have been due to decreased relative humidity which was generally below 60.0% and a low temperature varying from 20.0°C to 24.0°C. An almost complete absence of the beetles in the months of December, January and February was perhaps due to extremely low temperatures, ranging from 13.2°C to 17.6°C. The beetles could again be seen in the month of March when there was an appreciable increase in temperature.

The comparative resistance of Solanum melongena baromashi to the attack of Epilachna vigintioctopunctata and Epilachna dodecastigma may have been due to the presence of comparatively large and dense hairs upon its leaves.

CONCLUSIONS

1. Epilachna vigintioctopunctata and Epilachna dodecastigma are serious pests of Solonaceous and Cucurbitaceous plants and cause considerable losses to the agriculturists.

2. Temperature has a marked effect on the occurance of Epilachna vigintioctopunctata and Epilachna dodecastigma. Temperatures ranging from 27.0°C to 29.0°C seem to be more favourable than those varying from 20.0°C to 24.0°C, while those ranging from 13.2°C to 17.6°C and above 30.0°C are unfavourable for the occurrance of the beetles under field conditions.

3. The beetles prefer a relative humidity, ranging from 74.2% to 86.99%.

4. Solanum melongena baromashi is comparatively more resistant to the attack of the beetles than the hybrid of Solanum melongena pusa purple long X Solanum incanum.

5. Epilachna vigintioctopunctata oviposits on the undersurface of host plant leaves.

6. Preoviposition period in the case of Epilachna vigintioctopunctata varies from 14 to 19 days and each

female lays 107 to 238 eggs over a period of 26 to 39 days. Post-oviposition period varies from 22 to 36 days.

7. There are four larval instars, lasting for 73 to 78 hours, 66 to 68 hours, 86 to 90 hours and 4 to 5 days respectively. Pupal duration lasts for 4 to 5 days.

8. Females live longer than the males and on an average, they survive for 78.8 days and 58.3 days respectively.

SUMMARY

The phytophagous beetles, Epilachna vigintioctopunctata and Epilachna dodecastigma are serious pests of many solonaceous and cucurbitaceous plants. They feed upon the leaves, fruits and other tender parts of host plants and cause considerable losses to the agriculturists. It was therefore, considered desirable to study the bionomics of these beetles with a view to suggest suitable methods for their control.

Field studies on the seasonal abundance of Epilachna vigintioctopunctata and Epilachna dodecastigma were made at Sindia fort, Aligarh. It was found that fluctuations in the population density of both the species was largely dependent upon temperature and humidity conditions. Temperatures ranging from 27.0°C to 29.0°C were found to be favourable for the occurance of the beetles and both the species could be abundantly found in the field at these temperatures, during the months of July to October. A temperature ranging from 20.0°C to 24.0°C and above 30.0°C was however, less favourable and significant reduction in the population density of Epilachna vigintioctopunctata and Epilachna dodecastigma, in the months of November, April and May when such temperatures prevailed. During the months of December, January and February when the temperature varied from 13.2°C to 17.6°C, almost no beetles could be seen in the field.

The population was also found to be effected through changes in humidity. A relative humidity of 74.2% to 86.99% was found to be

favourable whereas a relative humidity of 60.0% was less favourable.

The population density of Epilachna vigintioctopunctata and Epilachna dodecastigma varied in the different plots studied. The beetles were most abundant in plot A, where the hybrid variety of Solanum melongena pusa purple long X Solanum incanum was grown. In this plot, 54.25 beetles belonging to the species Epilachna vigintioctopunctata and 48.16 beetles of the species Epilachna dodecastigma could be collected from a single plant in the month of August. As compared to this in plot C, where Solanum melongena baromashi was grown, only 11.39 and 8.81 adults of Epilachna vigintioctopunctata and Epilachna dodecastigma respectively could be collected from a single plant.

The eggs of Epilachna vigintioctopunctata are laid in batches on the undersurfaces of the brinjel leaves. Their long axis remains perpendicular to the leaf surface. They are elliptical in shape and bright yellow in colour, at the time of laying. The colour however, changes to light yellow with the advancement of the developmental period.

Preoviposition period varied from 14 to 19 days and a female laid 107 to 238 eggs over a period of 26 to 34 days. An egg measured from 1.1187 mm. to 1.2204 mm. in length and .4407 to .5085 mm. in width. During the present studies the incubation period was found to vary from 4 to 5 days at a temperature of 27± 1°C and 60 to 70 % relative humidity.

The larvae were reared individually as well as collectively. They were fed on fresh brinjal leaves. There were four larval instars in the case of Epilachna vigintioctopunctata, the existance of the four instars was checked by Dyar's Law (1890), which utilizes the ratio of increase in the width of head capsule in successive instars in the life cycle of an insect. The calculated widths were close to measured ones, suggesting thereby that no ecdysis had been overlooked.

The palish first instar larva of Epilachna vigintioctopunctata measure 1.1896 to 1.2643 mm. in length and .4407 to .5284 mm. in width. The body is covered with dorsal, subdorsal and dorso-lateral spines. The second instar larva resembles the first instar one except that the abdomen is somewhat bent and this gives the larva a hump backed appearance. Second instar larva measure from 2.3053 mm. to 2.4899 mm. in length and .7797 mm. to .8644 mm. in width.

The third instar larva is a varocious feeder of brinjal leaves and measures from 3.0849 mm. to 3.2713 mm. in length and .8475 mm. to 1.0804 mm. in width. It resembles the second instar larva except that the dark stripes on either side of the mid dorsal line of the thorax become distinct.

The fourth instar larva can be easily distinguished by its large size. It is 4.7799 mm. to 5.0173 mm. long and 1.4238 mm. to 1.7119 mm. wide.

The duration of the first, second, third and fourth instar

larvae varied from 73 to 78 hours, 66 to 68 hours , 86 to 90 hours and 4 to 5 days respectively.

Pupation occurs on brinjal leaves. When about to pupate the larva attaches itself to a leaf. In the beginning it is whitish in colour but later assumes yellow colouration. Gradually brown markings appear on the dorsal surface and wing covers and other body appendages become apparent. During the present studies the pupal period lasted for 4 to 5 days.

The adult emerges by breaking the pupal covering and takes about thirteen minutes to free itself from the pupal covering. Soon the wings harden and the beetles start feeding on the host plants.

Females live longer than males and the author could determine a longevity of 58.3 days for the males and 78.8 days for the females.

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